A Java-based WWW Client/Server Prototype for Distributed Cardiac SPECT Data Processing

Ping-Chun Chiao, Ph.D., Edward P. Ficaro, Ph.D., and Neal H. Clinthorne, M.S.
Department of Internal Medicine/ Division of Nuclear Medicine
University of Michigan, Ann Arbor, Michigan

Background. In the field of medical image processing algorithm development, it is critical that one conducts multi-center trials to evaluate new algorithms. Such evaluations require that every participating institution has access to the software, and preferably the same implementation. However, it has been very difficult to organize such evaluations because different institutions have different equipment that may have different file formats and computing platforms. Until now, providing "easy access" would simply mean tedious work of converting file formats and dealing with platform differences.

To provide "easy access", we propose to develop an Internet-based distributed data processing paradigm.[1] A platform independent user interface will allow users to work up the data locally and to submit data processing requests to a remote central site. A server running on the central site computer will monitor all computers dedicated to data processing including user's computers and distribute processing tasks to these computers based on their computing power and availability. Both user interface and server software will conform to DICOM (Digital Imaging & Communications in Medicine) open standards.

To investigate the feasibility of this paradigm, we have developed a Java-based WWW client/server prototype. This prototype will be used to provide distributed data processing services to the cardiac SPECT (Single Photon Emission Computed Tomography) community. In the initial phase of our investigations, we have focused on the design of user interfaces, client/server communications, and performance evaluations. This paper summarizes our initial findings.

Methods. User interfaces were developed in Java applets using Sun JDK 1.0.2. Server software was developed as Java servlets instead of conventional CGI scripts, and the Sun Web Server (code name Jeeves) was used as the backbone server. A WWW home page was used to invoke a servlet running on the server at user's requests. The servlet generated a second WWW page containing a Java applet and returned the WWW page to users. The applet allowed users to visualize projection data, to select the range of slices to be reconstructed using penalized weighted least-squares reconstruction with positivity constraints, to set reconstruction parameters for both emission and transmission data[2], and to submit a processing request. In response to the request, a second servlet was invoked. This servlet first initiated the reconstruction processes, monitored the processes, and then returned results to the applet for display as soon as the reconstruction was complete.

Evaluation. With Sun Web Server running on a 200-MHz Pentium-powered PC, we have tested the applet and communications between the applet and the server on a DEC Alpha workstation, a portable PC with a 120-MHz Pentium processor, and a previous generation Power Macintosh with a 60-MHz processor. Java-enabled Netscape was used in every case. While both the DEC Alpha and the portable PC provided responsive user interfaces and fast image display and animation, the Macintosh showed a significantly slower performance. We have also observed slow performance in transferring data between client and server. To locate the bottleneck, we compared Ethernet network access to modem network access on the portable PC and found that modem network access provided slower data transfer rates but it could not account for the overall slow performance.

Conclusion. Our initial experience with the Java-based WWW client/server prototype is encouraging. Our tests demonstrate that both Java user interfaces and Java-based servers can be adequately supported even by modern PCs. However, the performance of client and server communications and its dependency on the network bandwidth need to be investigated further.

References

1. Clinthorne NH, Chiao PC. Framework for community-wide evaluation of nuclear medicine data processing methods. To be published, Proceedings of the 44th Annual Meeting, Society of Nuclear Medicine.
2. Ficaro EP, Fessler JA, Shreve PD, Kritzman JN, Rose PA, Corbett JR. Simultaneous transmission/emission myocardial perfusion tomography. Diagnostic accuracy of attenuation-corrected 99mTc-sestamibi single- photon emission computed tomography. Circulation, 1996; 93:463-73.

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